BRIGHAM YOUNG
UNIVERSITY
IDAHO

RECEIVED

MAY 01 2008

Department of Environmental Quality
State Air Program

April 29, 2008

Air Quality Program Office – Application Processing
Department of Environmental Quality
1410 N. Hilton
Boise, ID 83706-1255

RE: Renewal of Tier II air quality permit for BYU-Idaho

Please accept the attached"Permit to construct application" in application for the renewal of the BYU-Idaho Tier II operating permit. BYU-Idaho has contracted with Stanley Consultants to provide a dispersion model, 2 copies of the model and 1 disc are attached to this letter along with a certification letter as per IDEQ requirements.

The dispersion model is based on the current configuration of the campus. Over the past few months in conversation with your office BYU-Idaho has mentioned we are in the process of designing and adding additional facilities to the campus. The noted construction is in progress and is slated for completion by late fall of 2010. We fully understand the noted construction will change the dispersion model and BYU-Idaho will need to update the model to include the new facilities that will be added along with the supporting emergency generators that will be added to support the said facilities.

BYU-Idaho appreciates the support of IDEQ and we look forward to working with your office during this process. BYU-Idaho understands that we will be required to submit payment of $10,000.00 prior to the permit being issued. Are there any other costs that need to be addressed prior to the start of the permitting application process? Please let me know of any other requirements in order to start the permitting process.

Sincerely,

Wayne N. Clark
Director, Physical Facilities Operations
Brigham Young University-Idaho
208-496-2456
clarkw@byui.edu

BRIGHAM YOUNG
UNIVERSITY
IDAHO

RECEIVED

MAY 01 2003

Department of Environmental Quality
State Air Program

Cheryl A. Robinson, P.E.
Air Quality Permitting Engineer
Idaho Department of Environmental Quality
1410 N. Hilton
Boise, Idaho 83706-1255

RE: Facility ID No. 065-00011, Brigham Young University-Idaho, Rexburg
Dispersion Modeling for Tier II Operating Permit Renewal

Dear Cheryl:

Enclosed are two copies of an air quality dispersion modeling report to support the Brigham Young University-Idaho (BYU-I) Tier II Operating Permit renewal.

Please consider the following to be a certification statement, as required by IDEQ regulations for this dispersion modeling report:

> Based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete.

I am considered the responsible official. My signature on this letter should be considered to complete the document certification requirements of IDEQ.

If you have any questions about the technical content of the modeling report, please contact Al Oestmann of Stanley Consultants at 319-626-5310.

Sincerely,

Wayne Clark
Director, Physical Facilities
Brigham Young University-Idaho

RECEIVED

MAY 01 2008

Department of Environmental Quality
State Air Program

Cover Sheet **Form CS**

DEQ AIR QUALITY PROGRAM
1410 N. Hilton, Boise, ID 83706
For assistance, call the
Air Permit Hotline – 1-877-5PERMIT

PERMIT TO CONSTRUCT APPLICATION

Revision 3
04/03/07

Please see instructions on page 2 before filling out the form.

DEQ USE ONLY
Date Received
Project Number
Payment / Fees Included? Yes ☐ No ☒
Check Number

COMPANY NAME, FACILITY NAME, AND FACILITY ID NUMBER

1. Company Name	Brigham Young University Idaho		
2. Facility Name	Central Heating Plant	3. Facility ID No.	065-00011
4. Brief Project Description - One sentence or less	TIER II OPERATING PERMIT RENEWAL		

PERMIT APPLICATION TYPE

5. ☐ New Facility ☐ New Source at Existing Facility ☐ Unpermitted Existing Source
☒ Modify Existing Source: Permit No.: P-060500 Date Issued: 4/9/2003, expires 4/9/2008
☐ Required by Enforcement Action: Case No.:____

6. ☐ Minor PTC ☐ Major PTC

FORMS INCLUDED

Included	N/A	Forms	DEQ Verify
☒	☐	Form GI – Facility Information	☐
☐	☐	Form EU0 – Emissions Units General	☐
☒	☐	Form EU1 - Industrial Engine Information Please Specify number of forms attached: 0	☐
☐	☐	Form EU2 - Nonmetallic Mineral Processing Plants Please Specify number of forms attached: ____	☐
☐	☐	Form EU3 - Spray Paint Booth Information Please Specify number of forms attached: ____	☐
☐	☐	Form EU4 - Cooling Tower Information Please Specify number of forms attached: ____	☐
☐	☐	Form EU5 – Boiler Information Please Specify number of forms attached: ____	☐
☐	☐	Form HMAP – Hot Mix Asphalt Plant Please Specify number of forms attached: ____	☐
☐	☐	Form CBP - Concrete Batch Plant Please Specify number of forms attached: ____	☐
☐	☐	Form BCE - Baghouses Control Equipment	☐
☐	☐	Form SCE - Scrubbers Control Equipment	☐
☒	☐	Forms EI-CP1 - EI-CP4 - Emissions Inventory– criteria pollutants (Excel workbook, all 4 worksheets)	☐
☐	☐	PP – Plot Plan	☐
☐	☐	Forms MI1 – MI4 – Modeling (Excel workbook, all 4 worksheets)	☐
☐	☐	Form FRA – Federal Regulation Applicability	☐

DEQ AIR QUALITY PROGRAM
1410 N. Hilton, Boise, ID 83706
For assistance, call the
Air Permit Hotline – 1-877-5PERMIT

PERMIT TO CONSTRUCT APPLICATION

Revision 3
03/26/07

Please see instructions on page 2 before filling out the form.

All information is required. If information is missing, the application will not be processed.

IDENTIFICATION	
1. Company Name	Brigham Young University Idaho
2. Facility Name (if different than #1)	Central Heating Plant
3. Facility I.D. No.	065-00011
4. Brief Project Description:	Renew Tier II Operating Permit & include 3 new exempt generators in modeling
FACILITY INFORMATION	
5. Owned/operated by: (√ if applicable)	☐ Federal government ☐ County government ☐ State government ☐ City government
6. Primary Facility Permit Contact Person/Title	Wayne N. Clark, Director, Physical Facilities
7. Telephone Number and Email Address	(208) 496-2456 clarkw@byui.edu
8. Alternate Facility Contact Person/Title	Kyle Williams, Mechanical Operations Supervisor
9. Telephone Number and Email Address	208-496-2484 williamsk@byui.edu
10. Address to which permit should be sent	528 S. Center
11. City/State/Zip	Rexburg, Idaho 83460-8205
12. Equipment Location Address (if different than #10)	Corner of 4th South and 1st West
13. City/State/Zip	Rexburg, Idaho
14. Is the Equipment Portable?	☐ Yes ☒ No
15. SIC Code(s) and NAISC Code	Primary SIC: 8222 Secondary SIC (if any): NAICS:
16. Brief Business Description and Principal Product	University
17. Identify any adjacent or contiguous facility that this company owns and/or operates	
PERMIT APPLICATION TYPE	
18. Specify Reason for Application	☐ New Facility ☐ New Source at Existing Facility ☐ Unpermitted Existing Source ☒ Modify Existing Source: Permit No.: P-060500 Date Issued: 4/9/2003, expires 4/9/2008 ☐ Permit Revision ☐ Required by Enforcement Action: Case No.:_____

CERTIFICATION

IN ACCORDANCE WITH IDAPA 58.01.01.123 (RULES FOR THE CONTROL OF AIR POLLUTION IN IDAHO), I CERTIFY BASED ON INFORMATION AND BELIEF FORMED AFTER REASONABLE INQUIRY, THE STATEMENTS AND INFORMATION IN THE DOCUMENT ARE TRUE, ACCURATE, AND COMPLETE.

19. Responsible Official's Name/Title	Wayne N. Clark Director, Physical Facilities Operations	
20. RESPONSIBLE OFFICIAL SIGNATURE		Date: 4/29/08
21. ☒ Check here to indicate you would like to review a draft permit prior to final issuance.		

Emissions Units - Industrial Engine Information **Form EU1**

PERMIT TO CONSTRUCT APPLICATION

Revision 3
03/27/07

DEQ AIR QUALITY PROGRAM
1410 N. Hilton, Boise, ID 83706
For assistance, call the
Air Permit Hotline – 1-877-5PERMIT

Please see instructions on page 2 before filling out the form. N/A, NO CHANGE ALL INFORMATION IN MODEL.

IDENTIFICATION		
Company Name: Brigham Young University Idaho	Facility Name: Central heating Plant	Facility ID No: 065-00011
Brief Project Description:	All required information is in appendix B of the attached Model	

EXEMPTION

Please refer to IDAPA 58.01.01.222.01.c and d for a list of internal combustion engines that are exempt from the Permit to Construct requirements.

ENGINE (EMISSION UNIT) DESCRIPTION AND SPECIFICATIONS

1. Type of Unit: ☐ New Unit ☐ Unpermitted Existing Unit ☐ Modification to a Unit with Permit #: Date Issued:

2. Use of Engine: ☐ Normal Operation ☐ Emergency ☐ Back-up ☐ Other:

3. Engine ID Number:	4. Rated Power: ☐ Brake Horsepower(bhp) ☐ Kilowatts(kW)	
5. Construction Date:	6. Manufacturer:	7. Model:
8. Date of Modification (if applicable):	9. Serial Number (if available):	10. Control Device (if any):

FUEL DESCRIPTION AND SPECIFICATIONS

11. Fuel Type	☐ Diesel Fuel (#) (gal/hr)	☐ Gasoline Fuel (gal/hr)	☐ Natural Gas (cf/hr)	☐ Other Fuels (unit:)
12. Full Load Consumption Rate				
13. Actual Consumption Rate				
14. Sulfur Content wt%		N/A	N/A	

OPERATING LIMITS & SCHEDULE

15. Imposed Operating Limits (hours/year, or gallons fuel/year, etc.):

16. Operating Schedule (hours/day, months/year, etc.):

Tier II Operating Permit Renewal PM_{10}, SO_2, NO_2, and CO Air Quality Dispersion Modeling Analysis

ORIGINAL

RECEIVED

MAY 01 2008

Department of Environmental Quality
State Air Program

Brigham Young University-Idaho
Rexburg, Idaho

Final
April, 2008

Stanley Consultants INC.

A Stanley Group Company
Engineering, Environmental and Construction Services - Worldwide

Table of Contents

Section 1

Introduction

The Idaho Department of Environmental Quality (IDEQ) has requested that Brigham Young University - Idaho (BYU-I), located in Rexburg, Idaho, perform a dispersion modeling analysis to demonstrate compliance with the National Ambient Air Quality Standards (NAAQS) for particulate matter less than or equal to ten microns in aerodynamic diameter (PM_{10}), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) to support the BYU-I Tier II operating permit renewal. The modeling analysis follows the methodology required in the IDEQ modeling guidelines and the modeling protocol submitted to IDEQ March 11, 2008, including the IDEQ response to the modeling protocol (Appendix A).

The modeling protocol included toxic air pollutants (TAPs) as part of the dispersion modeling analysis. This was done because at the time the protocol was created it was thought that three new emergency generators would be added to the campus. The new generators will not be installed for approximately two years (2010). Idaho regulations require modeling of TAPs only for emission increases (IDAPA 58.01.01.585 and 586). Because there will be no modifications to the existing sources, and the new generators are not being installed until 2010, there are no increases in TAPs emissions. Therefore, this analysis does not include modeling of TAPs.

The dispersion modeling analysis shows that all of the existing emission sources at BYU-I operating simultaneously will not cause predicted exceedances of any NAAQS.

Section 2

Modeling Procedures

2.1 Overview

This section describes the various options and assumptions used to model the air quality impact of the proposed source. Modeling techniques and emission estimates are contained in this section.

2.2 Air Quality Model Selection

The dispersion model chosen for this analysis is the American Meteorology Society / Environmental Protection Agency Regulatory Model (AERMOD), Version 07026. The AERMOD model is the "preferred" model by the U.S. Environmental Protection Agency (EPA). This model is an EPA technique that is capable of predicting short-term and annual concentrations for single or multiple stacks. The AERMOD model is also preferred because of the capability to simulate building downwash and terrain effects.

2.3 Model Assumptions and Controls

The AERMOD dispersion model has various options that must be selected to reflect the environmental conditions of the area to be modeled. Justification for the option selection is documented as follows:

2.3.1 Receptor Grid Development

The receptor grid consists of discrete receptors based on Universal Transverse Mercator (UTM) coordinates. The United States Geological Survey (USGS) topographical map of the Rexburg quadrangle uses North American Datum 1927 (NAD27), as do all other quadrangles and associated Digital Elevation Models (DEM) used in this analysis. The receptor grid consists of three elements containing 5,386 total receptors:

- A receptor grid with 25-meter (m) intervals covering an area with an East-West dimension of 1,075-m and a North-South dimension of 1,325-m centered on the BYU-I campus.
- A 50-m interval grid extending 500-m beyond the 25-m grid.
- A 100-m interval grid extending 1,000-m beyond the 50-m receptor grid.

The footprint of the campus buildings has been utilized to define ambient air. Therefore, receptors that fall inside campus buildings are omitted from the model

Elevated (flagpole) receptors are located at points where building windows may be opened or where there are fresh air intakes for a building. Campus buildings with operable windows are the Kirkham Building, the west part of the McKay Library, Perkins Hall, Kerr Hall, Barnes Hall, Chapman Hall, Lamprecht Hall, and Ricks Hall. In addition, Biddulph and Rigby Halls have small through-wall air conditioners which are treated as operable windows. This was done to ensure that the maximum predicted impacts are resolved in the analysis; therefore, flagpole receptors have not been placed on every campus building. Flagpole receptors are placed at the corners of the buildings listed above and at approximately 25-m intervals along the building walls that have operable windows. Vertical spacing of the flagpole receptors starts at 12 feet (3.66 m) above ground level and at 12 foot intervals above that until reaching the top of the building, or until the height above ground level with inoperable windows is reached since some buildings have inoperable windows above a certain height.

All elevations for receptors, emission sources, and buildings have been interpolated from U.S. Geological Survey Digital Elevation Model data for the Rexburg, Idaho, topographic quadrangle (NAD27).

2.3.2 Terrain Option

The approximate average elevation of Site is 1,495 m (4,905 feet) mean sea level (MSL) elevation. Terrain elevations will be input to the model using USGS DEM data in native format. The elevations in the receptor grid range from 4,846 to 5,230 feet mean sea level elevation (MSL). All receptors will be assigned a terrain height. The model will implement default settings for all regulatory options regarding terrain.

2.3.3 Domain

The modeling domain is required to encompass all significant terrain at or above a ten percent (10%) slope. To ensure that the domain includes the minimum area necessary to encompass all terrain at or above a 10% slope, the BYU-I domain will be set so that it is greater than four kilometers outside the receptor grid.

2.3.4 Rural/Urban

The AERMOD model allows the incorporation of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions. Use of the URBANOPT keyword allows the user to define input parameters for an urban area. The URBANSRC keyword is used to identify which sources are to be modeled with urban effects. The

Rexburg area does not have sufficient population to be considered "urban" for modeling purposes; therefore, the URBANOPT alternative was not utilized in this analysis.

2.3.5 Building Downwash Option

Section 123 of the Clean Air Act requires that regulations be promulgated (40 CFR § 51) to ensure that the degree of emission limitation required for the control of any air pollutant is not affected by:

- That portion of any stack height, which exceeds good engineering practice (GEP).
- Any other dispersion technique.

Section 123 defines GEP, with respect to stack heights, as the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source, as a result of atmospheric downwash, eddies, or wakes which may be created by the source itself, nearby structures, or nearby terrain obstacles. Section 123 further provides that GEP stack height shall not exceed 2½ times the height of the source unless a demonstration is performed justifying a higher stack.

Although there are exceptions for stacks in existence prior to 1979, for most stacks, GEP stack height is the greater of a height of 65 m (approximately 213.25 feet) that is considered de minimis stack height measured from the ground-level elevation at the base of the stack or according to the formula:

$GEP = H_b + 1.5 (L)$

Where:

H_b = Height of nearby structure measured from the elevation of the base of the stack.

L = Lesser dimension, height, or projected width of nearby structure.

40 CFR § 51 defines a nearby structure as 5L downwind or 2L upwind of a stack. These criteria were used to determine if a building has an influence on the plume from a particular stack. Buildings greater than 0.8 km (½ mile) from a stack are not considered to influence plume rise.

The six dormitory buildings in the northeast corner of the BYU-I campus are each 120 feet by 225 feet and highest point above ground on any of them is 20.5 feet. The nearest emission source (Kirkham Building Emergency Generator) to any of these buildings is approximately 148 feet distant, more than five building heights. Good Engineering Practice (GEP) regulations (40 CFR §51.100) define a nearby structure as a maximum horizontal distance of five times the lesser dimension, height, or projected width of the nearby structure to determine if a building or other structure has an influence on the plume from a particular stack. Because the nearest stack to any point on any of the six buildings is greater than five times the lesser dimension of the buildings, these buildings would not be included in the building downwash analysis and it is not necessary to include them in the site plan input to the model.

The BEELINE Software, Inc. dispersion modeling suite, BEEST for Windows, Version 9.72, was used to calculate wind direction specific building dimensions for all sources. All building dimensions, fenceline locations, and stack locations were taken from the site plan drawings of the facility included in this submittal. The Building Profile Input Program (BPIP) output has also been included on the CD-ROM accompanying this report.

2.3.6 Dispersion Techniques

No sources in this air dispersion modeling analysis use any of the dispersion techniques as defined in 40 CFR, Part 51, Section 100, Paragraph (hh).

2.3.7 Model Averaging Period Option

National Ambient Air Quality Standards (NAAQS) have been established for annual averaging periods for PM_{10}, SO_2, and, NOx; 24-hour averaging periods for PM_{10} and SO_2; 3-hour averaging periods for SO_2, and 1-hour and 8-hour averaging periods for CO. These averaging periods were investigated in this analysis.

NAAQS for PM_{10} is currently for 24-hour averaging periods only. Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the EPA revoked the annual PM_{10} NAAQS effective December 17, 2006. However, annual averaging periods were analyzed for PM_{10} concentrations because this is used as a surrogate for the annual $PM_{2.5}$ NAAQS, for which EPA has not determined modeling methodology.

The 24-hr PM_{10} NAAQS is in an "expected exceedances" format [40 CFR 50.6(a)]:

> "The standards are attained when the expected number of days per calendar year with a twenty-four hour average concentration above 150 $\mu g/m^3$, as determined in appendix K to this part, is equal to or less than one."

The IDEQ uses the pre-1997 method to model PM_{10} NAAQS compliance. This method, known as the highest sixth highest (H6H) method, consists of calculating the predicted 6^{th} highest 24-hr average concentration at each receptor for the entire 5-year period. The highest of these predicted 6^{th} highest concentrations is the value used for comparison to the NAAQS after adding the appropriate background concentration. A more conservative method is to use the highest second highest (H2H) 24-hr average for the five year period instead of the H6H method described above to determine compliance with this NAAQS. Either method may be used at the discretion of BYU-I as either H6H or H2H will demonstrate compliance with the 24-hr PM_{10} NAAQS. H2H concentrations have been used in this analysis.

2.3.8 Meteorological Data

IDEQ required that the most recent five year period of Rexburg (Madison County Airport) surface and Boise upper air meteorological data be used in this analysis. Therefore, 2003 through 2007 National Weather Service (NWS) was obtained and processed using the latest version of the EPA program AERMET. The model-ready meteorological data files and all raw meteorological data for both surface and upper air have been included on the CD-ROM accompanying this report.

The EPA program AERSURFACE was used to determine the surface characteristics (albedo, Bowen Ratio, and surface roughness) surrounding the Madison County Airport meteorological station for the surface data using USGS National Land Cover Data 1992 archives (NLCD92). AERSURFACE requires that the user determine the following:

- if the area is arid,
- is there at least one month of continuous snow cover,
- the moisture conditions of the individual years of meteorological data - wet, dry, or average.

Appendix A of the protocol (Appendix A of this report) contains data downloaded from the Western Regional Climate Center internet site (http://www.wrcc.dri.edu) that shows that:

1. The average annual precipitation for Rexburg is 13.31 inches per year for the period 7/1/1977 through 12/31/2005.
2. The average daily snow depth for the calendar months December, January, and February is six inches or more.

Together these data determine that Rexburg is not an arid area because:

- the most commonly used definition of arid conditions is that an area has less than 10 inches of annual precipitation,
- AERSURFACE assumes that if the location experiences continuous snow cover for at least one month during the year, that the area is non-arid.

The AERSURFACE User's Guide directs the user to determine the moisture condition by comparing the precipitation for the period of data to be processed to the 30-year climatological record, selecting "wet" conditions if precipitation is in the upper 30th-percentile, "dry" conditions if precipitation is in the lower 30th-percentile, and "average" conditions if precipitation is in the middle 40th-percentile.

There are large numbers of missing precipitation observations for the 2003-2007 period sometimes for two consecutive months or more. Therefore, moisture conditions at the site relative to climatological normals were determined to be average because of lack of data to the contrary.

The profile base elevation used in the AERMOD model is the base elevation of the meteorological tower at Rexburg (1480.7 m). The default values in the AERMOD model will be used for the upper bound of the wind speed categories.

2.3.9 Other Options

The regulatory default option was used to implement stack tip downwash, plume rise options, and calm wind conditions.

Section 3

Emission Rates and Stack Parameters

All sources in the model use potential emission rates. Emergency generator emission rates are based on the kilowatt output rating for each generator and AP-42 emission factors (Appendix B).

Appendix C is a listing of the BYU-I source input data containing the stack parameters and allowable emission rates in this analysis. The column in Appendix C defined by the heading "Horz. Exit" denotes the presence or absence of an obstructed or horizontally oriented stack. "YES" indicates stacks that are obstructed or that have an exit with an orientation other than vertical. "NO" indicates stacks with an unobstructed vertical exit.

For existing sources the same stack parameters that were used in the modeling analysis submitted in September 2006 were used with the exception of stack exit temperatures for the emergency generators. A conservatively low temperature of 600°F is assumed for the stack exit temperature for all of the emergency generators to conform with IDEQ policy.

Emission rates and stack parameters for the boilers have been supplied by BYU-I and/or are taken from the Title V permit for the facility. The virtual diameter for the Radio/Graphics Building Emergency Generator from a model input file supplied by IDEQ is also utilized. In addition, the following were used to determine input values for the model:

- SO_2 emission rates for the boilers reflect the use of coal with maximum sulfur (S) content levels of 0.72%.
- The exit temperatures and volume flow rates (and thus the exit velocities) reflect the results of stack testing on the four BYU-I boilers. Date of the stack test on Boilers 2 and 3 is April 11, 2006. The date of the latest Boiler 4 stack test is January 16, 2008. The stack tests were performed by Tetco of Lehi, Utah.

- SO_2 emission rates for Boiler No. 5 reflect the use of No.2 fuel oil with maximum sulfur content of 0.05% by weight.

- Four emergency generators (Boiler House, Kimball Building, Hart Building, and Physical Facilities) use stack parameters (other than stack temperature, 600°F is used for all generators) either from the Title V permit or from a model input file for these sources supplied by IDEQ.

- Emission rates for all emergency generators are calculated using AP-42 emission factors. Horsepower ratings have been calculated using a conversion factor of 1.341 horsepower per kilowatt because AP-42 emission rates are based on horsepower.

- Other than the Boiler House, Kimball Building Hart Building, and Clarke Building emergency generators, exit velocities for all generators have been assumed to be horizontal and use 0.0 m/s to insure that the most conservative modeling methodology is utilized. The Radio/Graphics Building stack is conservatively assumed to have an exit velocity of 0.0 m/s because of uncertainty about the orientation of the stack. The exit velocities used for the four generators that utilize a non-zero exit velocity are based on design volume flow at 600°F.

- The Kimball Building Emergency Generator has a horizontally-oriented stack. However, the actual dimensions, eight inches inside diameter and an exit velocity of 57.6 meters per second, was input to the model. Utilization of the actual diameter and exit velocity is based on a method suggested by IDEQ to resolve these stack parameters for this hot, horizontal source. The method suggested by IDEQ involves determination of whether momentum flux or buoyancy flux dominates plume rise from this stack. If thermal buoyancy is dominant, actual values are used for diameter and velocity. Calculations (Appendix D) determining the crossover point between momentum flux and thermal buoyancy flux have been performed using the highest ambient temperature in the meteorological data used in the AERMOD model, 2003 through 2007 for Rexburg, Idaho, and the design stack temperature of 1002°F. These calculations show that buoyancy will dominate plume rise under all stability conditions for the Kimball Building Emergency Generator, thus allowing the use of the actual diameter and exit velocity. At this time the Kimball Building Emergency Generator is the only source to which this methodology will be applied. However, BYU-I may use this methodology for other generators if and when appropriate.

- Two emergency generators are not included in the model, the Substation Generator and the Portable Generator because locations were not available for these two sources. As the name implies the Portable Generator is sited in various locations as needed. The Substation Generator is located in a field "more than a mile to the south and west of the campus" and for this reason is unlikely to interact with the other BYU-I sources.

- The emission rates of the BYU-I generators were adjusted to reflect limited operation. IDEQ is primarily interested in situations when the emergency electrical generators are operated for testing and maintenance, i.e., when other BYU-I sources (the boilers) are in operation. Normally operation of emergency generators for testing and maintenance occurs for one or two hours one day per month. Normal operation of the BYU-I generators will be assumed to be one day per month for three hours (three hours during a

24-hr period once per month). The emergency generators are permitted to operate up to 500 hours per year. The emission rates in the annual averaging period model have been adjusted by multiplying the allowable emission rates of the emergency generators by 500/8760 (0.0571). The emission rates for the 24-hr averaging period model have been adjusted by multiplying the allowable emission rates of the emergency generators by 3/24 (0.125). No adjustment was made to the allowable emission rates for the 1-hr, 3-hr, and 8-hr averaging periods.

Section 4

Modeling Results

The results of the modeling analysis for BYU-I are summarized in Appendix D. All model input, output, BPIP, and AERMET files are included on the enclosed CD-ROM.

For PM_{10} the maximum annual and highest second-highest predicted 24-hour concentrations are 4.15 $\mu g/m^3$ for annual averaging periods and 36.81 $\mu g/m^3$ for 24-hour averaging periods. Adding the 27 and 81 $\mu g/m^3$ PM_{10} background concentrations for annual and 24-hour averaging periods to the modeled concentrations results in total concentrations of 31.15 $\mu g/m^3$ for annual averaging periods and 117.81 $\mu g/m^3$ for 24-hour averaging periods. The total concentrations are less than the annual PM_{10} NAAQS of 50 and the 24-hr PM_{10} NAAQS of 150 $\mu g/m^3$.

For SO_2, the maximum annual and highest second highest predicted 24-hour concentrations are 30.67 $\mu g/m^3$ for annual periods, 142.80 $\mu g/m^3$ for 24-hr periods, and 1112.96 $\mu g/m^3$ for 3-hr periods. Addition of the background concentrations of 8 $\mu g/m^3$ for annual periods, 26 $\mu g/m^3$ for 24-hr periods, and 42 $\mu g/m^3$ for 3-hr periods to the modeled concentrations results in total concentrations of 38.67 $\mu g/m^3$, 168.80 $\mu g/m^3$, and 1154.96 $\mu g/m^3$ for annual, 24-hr and 3-hr averaging periods respectively. The total concentrations are less than the SO_2 NAAQS of 80 $\mu g/m^3$ for annual averaging periods, 365 $\mu g/m^3$ for 24-hr averaging periods, and 1300 $\mu g/m^3$ for 3-hr averaging periods.

For NO_2 the highest predicted concentration is 43.08 $\mu g/m^3$ for annual averaging periods. Adding the 32 $\mu g/m^3$ NO_2 background concentration for annual averaging periods to the modeled concentration results in a total concentration of 75.08 $\mu g/m^3$. The total concentration is less than the annual NO_2 NAAQS of 100 $\mu g/m^3$.

For CO the highest second-highest predicted 1-hour and 8-hour concentrations are 3568.97 $\mu g/m^3$ for 1-hour averaging periods and 1544.49 $\mu g/m^3$ for 8-hour averaging periods. Adding the 10,200 and 3,400 $\mu g/m^3$ CO background concentrations for 1-hour and 8-hour averaging periods to the modeled concentrations results in total concentrations of 13,768.97 $\mu g/m^3$ for 1-hour averaging periods and 4,944.49 $\mu g/m^3$ for 8-hour averaging periods. The total concentrations are less than the 1-hour CO NAAQS of 40,000 and the 8-hr CO NAAQS of 10,000 $\mu g/m^3$.

Appendix A

Modeling Protocol

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

1410 NORTH HILTON, BOISE, ID 83706 · (208) 373-0502

C. L. "BUTCH" OTTER, GOVERNOR
TONI HARDESTY, DIRECTOR

March 20, 2008

Allan R. Oestmann
Principal Air Quality Specialist
Stanley Consultants, Inc.

RE: Modeling Protocol for the Brigham Young University-Idaho Facility Located in Rexburg, Idaho

Dear Al:

DEQ received your dispersion modeling protocol on March 11, 2008. The modeling protocol was submitted on behalf of Brigham Young University-Idaho (BYU-Idaho), located in Rexburg, Idaho. The modeling protocol proposes methods and data for use in the ambient impact analyses of a Permit to Construct application for a modification to install three new emergency electrical generators at the facility and to renew the facility's Tier II operating permit, which will expire on April 9, 2008. This PTC will replace the expiring Tier II operating permit.

The modeling protocol has been reviewed and DEQ has the following comments:

- Comment 1: The application should provide documentation and justification for stack parameters used in the modeling analyses, clearly showing how stack gas temperatures and flow rates were estimated. Include calculations and assumptions. In most instances, applicants should use typical parameters, not maximum temperatures and flow rates. Documentation should be provided for each point of emissions in the modeling analysis.

  Even though many of the exhaust parameters have been used in past modeling demonstrations, DEQ request that the supporting documentation be provided with each individual application submittal regardless of whether this information was provided in the past. This request follows the current streamlined permitting methods DEQ has implemented to reduce processing timeline and application completeness issues. Refinement of exhaust parameters, and in some cases, outright corrections of values used in historical modeling analyses have occurred due to the substantiation requirement.

  Sources of supporting documentation include source testing data, manufacturer's design information, on-site measurement during normal operation, and others. If source test data is used to establish exhaust parameters, please include the test report date.

  Where an exhaust velocity of 0.001 meters per second is used, detailed verification of the exhaust flow rate is not warranted.

- Comment 2: The proposed receptor grid of ground-level and flagpole receptors appears reasonable. However, it is the applicant's responsibility to use a sufficiently tight receptor network such that the maximum modeled concentration is reasonably resolved. If DEQ conducts verification modeling analyses with a tighter receptor grid and compliance with standards is no longer demonstrated, the permit will be denied.

- Comment 3: When modeling carcinogenic TAPs, the applicant may use a 5-year meteorological data set, using the period average concentration, rather than five separate 1-year data sets.

- Comment 4: DEQ determined that default background concentrations for small town/suburban areas for PM_{10}, CO, SO_2, NO_2, and lead are most appropriate for the site location in Rexburg. DEQ's recommended background concentrations are: PM_{10} 24-hr = 81 $\mu g/m^3$; PM_{10} annual = 27 $\mu g/m^3$; CO 1-hr = 10,200 $\mu g/m^3$; CO 8-hr = 3,400 $\mu g/m^3$; NO_2 annual = 32 $\mu g/m^3$; SO_2 3-hr = 42 $\mu g/m^3$; SO_2 24-hr = 26 $\mu g/m^3$; SO_2 annual = 8 $\mu g/m^3$; and, Pb quarterly = 0.03 $\mu g/m^3$.

- Comment 5: DEQ permitting staff has not reviewed the emission inventory submitted in the modeling protocol for completeness and accuracy. Review will be conducted after the official permit application is received by DEQ.

DEQ's modeling staff considers the submitted dispersion modeling protocol, with resolution of the additional items noted above, to be approved. It should be noted, however, that the approval of this modeling protocol is not meant to imply approval of a completed dispersion modeling analysis. Please refer to the *State of Idaho Air Quality Modeling Guideline*, which is available on the Internet at http://www.deq.state.id.us/air/permits_forms/permitting/modeling_guideline.pdf, for further guidance.

If you have any further questions or comments, please contact me at (208) 373-0536.

Sincerely,

Darrin Mehr

Darrin Mehr
Air Quality Analyst
Idaho Department of Environmental Quality

Dispersion Modeling Protocol

Brigham Young University - Idaho
Rexburg, Idaho

Final
March, 2008

Table of Contents

Brigham Young University - Idaho

Dispersion Modeling Protocol

Project Description and Purpose of Modeling Analysis

Brigham Young University - Idaho (BYU-I), located in Rexburg, Idaho, is proposing to install three new emergency generators. Rexburg is a Class II area currently designated attainment for all criteria pollutants. The Idaho Department of Environmental Quality (IDEQ) has requested that BYU-I perform a full impact dispersion modeling analysis including all facility sources to support the Permit to Construct Application (PTC) for these generators to demonstrate compliance with the National Ambient Air Quality Standards (NAAQS) for particulate matter less than or equal to ten microns in aerodynamic diameter (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), and nitrogen dioxide (NO_2). The modeling analysis will follow the methodology required in the IDEQ modeling guidelines.

A. Proposed Modeling Procedures

This section describes the options and assumptions to be used in the air quality dispersion modeling analysis.

1. Air Quality Model Selection

The dispersion model proposed for this analysis is the **A**MS/**E**PA **R**egulatory **Mod**el (AERMOD), Version 07026. The AERMOD model is the model designated "preferred" by EPA. It is an EPA technique that is capable of predicting short-term and annual concentrations for single or multiple stacks. The AERMOD model is also preferred because of the capability to simulate building downwash and terrain effects.

2. Model Assumptions and Controls

The AERMOD dispersion model has various options that must be selected to reflect the environmental conditions of the area to be modeled. Justification for the option selection is documented as follows:

a. Receptor Grid Development - The receptor network will consist of discrete receptors located around Site in a Cartesian coordinate grid based on Universal Transverse Mercator (UTM) coordinates. The United States Geological Survey (USGS) topographical map of the Rexburg quadrangle uses North American Datum 1927 (NAD27), as do all other quadrangles and associated Digital Elevation Models (DEM) used in this analysis. The southwest corner of the receptor grid is located at UTMX=435,000 m, UTMY=4,849,500 m. The receptor grid will consist of the following elements:

- A receptor grid with 25-meter intervals covering an area with an East-West dimension of 1,075 m and a North-South dimension of 1,325 m centered on the BYU-I campus.
- A 50 m interval grid extending 500 m beyond the 25-m receptor grid.
- A 100 m interval grid extending 1,000 m beyond the 50-m receptor grid.

The footprint of the campus buildings will be utilized to define ambient air. Therefore, receptors in the 25 m, 50 m, and 100 m receptor grids that fall inside campus buildings will be omitted from the model

Elevated (flagpole) receptors will be located at points where building windows may be opened or where there are fresh air intakes for a building. Campus buildings with operable windows are the Kirkham Building, the west part of the McKay Library, Perkins Hall, Kerr Hall, Barnes Hall, Chapman Hall, Lamprecht Hall, Ricks Hall. In addition, Biddulph and Rigby Halls have small through-wall air conditioners which will be treated as operable windows. This will be done to insure that the maximum predicted impacts are resolved in the analysis; therefore, flagpole receptors will not be placed on every campus building. Flagpole receptors will be placed at the corners of the buildings listed above and at approximately 25 m intervals along the building walls that have operable windows. Vertical spacing of the flagpole receptors will start at 12 feet (3.66 m) above ground level and at 12 foot intervals above that until reaching the top of the building, or until the height above ground level with inoperable windows is reached since some buildings have inoperable windows above a certain height.

b. Terrain Option - The approximate average elevation of Site is 1,495 m (4,905 feet) mean sea level (MSL) elevation. Terrain elevations will be input to the model using USGS DEM data in native format. The elevations in the receptor grid range from 4,846 to 5,230 feet mean sea level elevation (MSL). All receptors will be assigned a terrain height. The model will implement default settings for all regulatory options regarding terrain.

c. Domain –The modeling domain is required to encompass all significant terrain at or above a ten percent (10%) slope. To insure that the domain includes the minimum area necessary to encompass all terrain at or above a 10% slope, the BYU-I domain will be set so that it is equal to or greater than four kilometers outside the receptor grid.

d. Rural/Urban Option - The AERMOD model allows the user to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions. The user defines the input parameters for the urban area with the URBANOPT keyword on the CO pathway, and then identifies which sources are to be modeled with urban effects using the URBANSRC keyword. The Rexburg area does not have sufficient population to considered "urban" for modeling purposes; therefore, none of the sources included in the model will utilize the URBANOPT alternative.

e. Building Profile Input Program - Section 123 of the Clean Air Act requires that regulations be promulgated (40 CFR § 51) to ensure that the degree of emission limitation required for the control of any air pollutant is not affected by:

- That portion of any stack height, which exceeds good engineering practice (GEP).
- Any other dispersion technique.

Section 123 defines GEP, with respect to stack heights, as the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, or wakes which may be created by the source itself, nearby structures, or nearby terrain obstacles. Section 123 further provides that GEP stack height shall not exceed 2½ times the height of a building capable of affecting a stack unless a demonstration is performed justifying a higher stack.

Although there are exceptions for stacks in existence prior to 1979, for most stacks, GEP stack height is the greater of:

- a height of 65 m (approximately 213.25 feet) *de minimis* stack height measured from the ground level elevation at the base of the stack
- or according to the formula:

$$GEP = H + 1.5(L)$$

Where:

- H = Height of nearby structure measured from the elevation of the base of the stack
- L = Lesser dimension, height, or projected width of nearby structure(s).

40 CFR § 51.100 defines a nearby structure as within 5L of a stack, but not greater than 0.8 kilometers (½ mile) from the stack. These criteria will be used to determine if a building has an influence on the plume from a particular stack. Buildings greater than 0.8 km (½ mile) from a stack are not considered to influence plume rise.

The Bowman Environmental Engineering, Inc. program, BEEST for Windows, Version 9.72 (or later version if one becomes available before the model is submitted for review), will be used to calculate wind direction specific building dimensions for all sources. BEEST includes the current code from EPA's Prime Building Profile Input Program (BPIP-PRIME), and is guaranteed to be consistent with the BPIP-PRIME output. All building dimensions will be taken from a site plan drawing of the campus buildings and stack locations.

f. Dispersion Techniques – No sources in this model will use dispersion techniques as defined in 40 CFR, Part 51, Section 100, Paragraph (hh). If stacks to which the dispersion techniques rules apply are constructed, they will be modeled as appropriate under these rules.

g. Model Averaging Period Option – The following criteria pollutants will be modeled: particulate matter less than or equal to ten microns in aerodynamic diameter (PM_{10}), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) will be modeled to determine if predicted concentrations (first high concentrations for annual and highest second highest concentrations for 24-hour and shorter averaging periods), plus background concentrations determined by IDEQ, exceed the NAAQS for these pollutants. Toxic Air Pollutants (TAPs) for which total potential emissions for all three emergency generators exceed the screening emissions levels (EL) will also be included in this modeling analysis. National Ambient Air Quality Standards (NAAQS) have been established for 1-hour, 3-hour, 8-hour, 24-hour, and annual averaging periods for the criteria pollutants. TAPs will be modeled for 24-hour and annual averaging periods.

NAAQS for PM_{10} is currently for 24-hour averaging periods only. Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the EPA revoked the annual PM_{10} NAAQS effective December 17, 2006. However, annual averaging periods will analyzed for PM_{10} concentrations because this is used a surrogate for the annual $PM_{2.5}$ NAAQS, for which EPA has not determined modeling methodology.

The 24-hr PM_{10} NAAQS is in an "expected exceedances" format [40 CFR 50.6(a)]:

> "The standards are attained when the expected number of days per calendar year with a twenty-four hour average concentration above 150 $\mu g/m^3$, as determined in appendix K to this part, is equal to or less than one."

The IDEQ uses the pre-1997 method to model PM_{10} NAAQS compliance. This method, known as the highest sixth highest (H6H) method, consists of calculating the predicted 6th highest 24-hr average concentration at each receptor for the entire 5-year period. The highest of these predicted 6th highest concentrations is the value used for comparison to the NAAQS after adding the appropriate background concentration. A more conservative method is to use the highest second highest (H2H) 24-hr average for the five year period instead of the H6H method described above to determine compliance with this NAAQS. Either method may be used at the discretion of BYU-I as either H6H or H2H will demonstrate compliance with the 24-hr PM_{10} NAAQS.

h. Meteorological Data – IDEQ is requiring that the most recent five year period of Rexburg (Madison County Airport) surface and Boise upper air meteorological data be used in this analysis. Therefore, 2003 through 2007 National Weather Service (NWS) will be obtained and processed using the latest version of the EPA program AERMET. The model-ready meteorological data files and all raw meteorological data for both surface and upper air will be included with the modeling report submitted to IDEQ.

The EPA program AERSURFACE was used to determine the surface characteristics (albedo, Bowen Ratio, and surface roughness) surrounding the Madison County Airport meteorological station for the surface data using USGS National Land Cover Data 1992 archives (NLCD92). AERSURFACE requires that the user determine the following:

- if the area is arid,
- is there at least one month of continuous snow cover,
- and the moisture conditions of the individual years of meteorological data wet, dry, or average.

Appendix A contains data downloaded from the Western Regional Climate Center internet site (http://www.wrcc.dri.edu) that shows that:

1. The average annual precipitation for Rexburg is 13.31 inches per year for the period 7/1/1977 through 12/31/2005.

2. The average daily snow depth for the calendar months December, January, and February is six inches or more.

Together these data determine that Rexburg is not an arid area because:

- the most commonly used definition of arid conditions is that an area has less than 10 inches of annual precipitation,

- and AERSURFACE assumes that if the location experiences continuous snow cover for at least one month during the year, that the area is non-arid.

The AERSURFACE User's Guide directs the user to determine the moisture condition by comparing the precipitation for the period of data to be processed to the 30-year climatological record, selecting "wet" conditions if precipitation is in the upper 30th-percentile, "dry" conditions if precipitation is in the lower 30th-percentile, and "average" conditions if precipitation is in the middle 40th-percentile.

There are large numbers of missing precipitation observations for the 2003-2007 period sometimes for two consecutive months or more. Therefore, moisture conditions at the site relative to climatological normals were determined to be average because of lack of data to the contrary.

The profile base elevation used will be the base elevation of the meteorological tower at Rexburg (1480.7 m). The default values in the AERMOD model will be used for the upper bound of the wind speed categories.

i. Other Options - The regulatory default option in AERMOD will be used to implement stack tip downwash, elevated terrain, calms processing, missing data, and plume rise options.

B. Emission Rates and Stack Parameters

All sources will be entered into the model using potential emission rates. Appendix B is a listing of the BYU-I source input data containing the stack parameters and allowable emission rates in this analysis. The column in Appendix B defined by the heading "Horz. Exit" denotes the presence or absence of an obstructed or horizontally oriented stack. "YES" indicates stacks that are obstructed or that have an exit with an orientation other than vertical. "NO" indicates stacks with an unobstructed vertical exit.

The three proposed generators do not appear in Appendix B or on the site plan because the vendors for these sources have not yet been determined. Nor have precise locations been determined at this time. These data will be included in the model input list and site plan in the modeling report submitted to IDEQ.

For existing sources the same emission rates and stack parameters that were used in the modeling analysis submitted in September 2006 will be used. These input data were approved by IDEQ. The following discussion details how these model input parameters were determined.

Emission rates and stack parameters for the boilers and many of the generators in the model are supplied by BYU-I and/or are taken from the Title V permit for the facility. The virtual diameter for the Radio/Graphics Building Emergency Generator from a model input file supplied by IDEQ are also utilized. In addition, the following were used to determine input values for the model:

- SO_2 emission rates for the boilers reflect the use of coal with maximum sulfur (S) content levels of 0.72%.

- The exit temperatures and volume flow rates (and thus the exit velocities) reflect the results of stack testing on the four BYU-I boilers performed in 2006.

- SO_2 emission rates for Boiler No. 5 reflect the use of No.2 fuel oil with maximum sulfur content of 0.05% by weight.

- Four emergency generators (Boiler House, Kimball Building, Hart Building, and Physical Plant) use stack parameters and emission rates either from the Title V permit or from a model input file for these sources supplied by IDEQ.

  All other emergency generator emission rates are estimated based on power output (kW) because design data is not available. Emissions for these generators are calculated using AP-42 emission factors. Horsepower ratings have been calculated using a conversion factor of 1.341 horsepower per kilowatt because AP-42 emission rates are based on horsepower.

  With two exceptions exit velocities for all generators have been assumed to be horizontal using 0.001 m/s to insure that the most conservative modeling methodology is utilized. The Radio/Graphics Building and Clarke Building Emergency Generators design volume flows are available and will be used in the model. The Radio/Graphics Building stack is conservatively assumed to have an exit velocity of 0.001 m/s because of uncertainty about the orientation of the stack. Design volume flow and temperature is available for the Clarke Building Emergency Generator; therefore, this data is input to the model, as this stack orientation has been modified to a vertical, unobstructed exit.

  Exit temperatures for all generators, other than the Clarke Building as stated above, are assumed to be 600°F, a low temperature for an engine exhaust, and therefore conservative.

  Two emergency generators are not included in the model, the Substation Generator and the Portable Generator because locations were not available for these two sources. As the name implies the Portable Generator is sited in various locations as needed. The Substation Generator is located in a field "far to the south and west of the campus" and for this reason is unlikely to interact with the other BYU-I sources.

- The Kimball Building Emergency Generator has a horizontally-oriented stack. However, the actual dimensions, eight inches inside diameter and an exit velocity of 57.6 meters per second, will be input to the model. Utilization of the actual diameter and exit velocity is based on a method suggested by IDEQ to resolve these stack parameters for this hot, horizontal source. The method suggested by IDEQ involves determination of whether momentum flux or buoyancy flux dominates plume rise from this stack. If thermal buoyancy is dominant, actual values are used for diameter and velocity. Calculations (Appendix C) determining the crossover point between momentum flux and thermal buoyancy flux have been performed using the highest ambient temperature in the meteorological data used in the AERMOD model, 2003 through 2007 for Rexburg, Idaho. These calculations show that buoyancy will dominate plume rise under all stability conditions for the Kimball Building Emergency Generator, thus allowing the use of the actual diameter and exit velocity. At this time the Kimball Building Emergency Generator is the only source to which this methodology will be applied. However, BYU-I may use this methodology for other generators if and when appropriate.

- The emission rates of the BYU-I generators will be adjusted to reflect limited operation. IDEQ is primarily interested in situations when the emergency electrical generators are operated for testing and maintenance, i.e., when other BYU-I sources (the boilers) are in operation. Normally operation of emergency generators for testing and maintenance occurs for one or two hours one day per month. Normal operation of the BYU-I generators will be assumed to be one day per month for three hours (three hours during a 24-hr period once per month). The emergency generators are permitted to operate up to 500 hours per year. The emission rates in the annual averaging period model will be adjusted by multiplying the allowable emission rates of the emergency generators by 500/8760 (0.0571). The emission rates for the 24-hr averaging period model will be adjusted by multiplying the allowable emission rates of the emergency generators by 3/24 (0.125). No adjustment will be made to the allowable emission rates for the 3-hr averaging period model.

C. Presentation of Modeling Results

A report will be submitted to the IDEQ documenting the modeling methodology and results of the procedures outlined in this modeling protocol. The modeling analysis report will also contain the following:

- Tables containing source parameters for sources input into the model.
- A site plan, to scale, of the campus with building dimensions, stack locations, and fenceline locations.
- A CD-ROM will be provided containing the entire model and building dimension program input and output listings necessary to evaluate the ambient air quality analysis. The CD-ROM will also contain the raw meteorological data, the AERSURFACE and AERMET input and output files, and the model-ready meteorological data files used in this analysis.
- A comparison of the predicted concentrations plus background concentrations for each NAAQS analyzed.

Appendix A

Rexburg Average Temperature, Precipitation, and Snow Depth

REXBURG RICKS COLLEGE, IDAHO (107644)

Period of Record Monthly Climate Summary

Period of Record : 7/ 1/1977 to 12/31/2005

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	29.4	33.4	46.2	57.3	65.9	74.6	83.5	84.3	73.9	60.3	41.4	30.3	56.7
Average Min. Temperature (F)	10.7	13.8	23.5	30.6	38.6	44.8	49.2	47.2	38.6	29.9	20.2	11.4	29.9
Average Total Precipitation (in.)	1.11	1.02	1.07	1.13	1.89	1.44	0.90	0.72	0.82	1.07	1.09	1.06	13.31
Average Total SnowFall (in.)	13.5	10.5	4.0	2.1	0.5	0.0	0.0	0.0	0.1	1.0	7.6	15.3	54.6
Average Snow Depth (in.)	9	8	4	0	0	0	0	0	0	0	1	6	2

Percent of possible observations for period of record.
Max. Temp.: 92.9% Min. Temp.: 93% Precipitation: 91.8% Snowfall: 92.1% Snow Depth: 85.6%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

Appendix B

BYU-Idaho Model Input

Appendix B
BYU-Idaho Model Input

Source Name	Source ID	Stack Ht. (ft.)	Stack Temp. (F)	Act. Stack Dia. (in)	Eff. Stack Dia. (ft)	Vol. Flow (ACFM)	Vol. Flow (SCFM)	Exit Vel. (ft/sec)	Horz Exit	PM10 Em. Rate (lb/hr)	SO2 Em. Rate (lb/hr)	NOx Em. Rate (lb/hr)	CO Em. Rate (lb/hr)	UTM Coord. (m)
1 Coal Boiler #2	BOILER2	80.00 24.38 m	406 480.63 K	30.00	2.50 0.76 m	19027	11648	64.60 19.69 m/sec	NO	4.640 0.585 g/sec	33.604 4.234 g/sec	2.450 0.309 g/sec	5.330 0.672 g/sec	X= 436871 Y= 4851715
2 Coal Boiler #3	BOILER3	80.00 24.38 m	343 445.63 K	38.00	3.17 0.97 m	35800	23637	75.76 23.09 m/sec	NO	5.500 0.693 g/sec	50.400 6.350 g/sec	3.680 0.464 g/sec	8.000 1.008 g/sec	X= 436875 Y= 4851715
3 Coal Boiler #4	BOILER4	80.00 24.38 m	496 530.63 K	37.99	3.17 0.96 m	35800	19853	75.80 23.10 m/sec	NO	8.910 1.123 g/sec	58.804 7.409 g/sec	4.290 0.541 g/sec	9.330 1.176 g/sec	X= 436890 Y= 4851716
4 Gas/Oil Boiler #5 (Note 1)	BOILER5	59.00 17.98 m	360 455.22 K	42.01	3.50 1.07 m	30328	19602	52.51 16.01 m/sec	NO	0.400 0.050 g/sec	6.667 0.840 g/sec	2.700 0.340 g/sec	4.200 0.529 g/sec	X= 436898 Y= 4851716
5 Boiler House Emer. Gen. (Note 2)	HEAT_GEN	47.01 14.33 m	852.73 728.96 K	5.98	0.50 0.15 m	2553	1031	218.15 66.49 m/sec	NO	0.880 0.111 g/sec	0.820 0.103 g/sec	12.472 1.571 g/sec	2.690 0.339 g/sec	X= 436894 Y= 4851708
6 Kimball Bldg Emer. Gen. (Notes 2 and 3)	KIMB_GEN	12.01 3.66 m	1002 811.74 K	8.00	0.67 0.20 m	3958	1000	188.98 57.60 m/sec	YES (Horiz)	1.290 0.163 g/sec	1.290 0.163 g/sec	18.206 2.294 g/sec	3.920 0.494 g/sec	X= 437266 Y= 4851610
7 Hart Bldg Emer. Gen. (Note 2)	HART_GEN	6.30 1.92 m	1002 811.74 K	2.01	0.17 0.05 m	251	91	189.77 57.84 m/sec	NO	0.295 0.037 g/sec	0.290 0.037 g/sec	4.157 0.524 g/sec	0.900 0.113 g/sec	X= 437008 Y= 4851994
8 Physical Plant Emer. Gen. (Note 2)	PHYP_GEN	41.00 12.50 m	600 588.56 K	3.00	0.25 0.08 m	5000	2500	0.00 0.00 m/sec	YES	0.088 0.011 g/sec	0.087 0.011 g/sec	1.246 0.157 g/sec	0.269 0.034 g/sec	X= 436904 Y= 4851558
9 Manwaring Center Emer. Gen. (Note 2)	MAN_GEN	150.00 45.72 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.176 0.022 g/sec	0.174 0.022 g/sec	2.492 0.314 g/sec	0.538 0.068 g/sec	X= 437096 Y= 4851827
10 Kirkham Bldg Emer. Gen. (Note 2)	KIRK_GEN	150.00 45.72 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.059 0.007 g/sec	0.058 0.007 g/sec	0.831 0.105 g/sec	0.179 0.023 g/sec	X= 437213 Y= 4852111
11 Auxillary Services Emer. Gen. (Note 2)	ASER_GEN	150.00 45.72 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.088 0.011 g/sec	0.087 0.011 g/sec	1.246 0.157 g/sec	0.269 0.034 g/sec	X= 437123 Y= 4851402
12 Austin Tech Emer. Gen. (Note 2)	AUST_GEN	6.25 1.91 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.088 0.011 g/sec	0.087 0.011 g/sec	1.246 0.157 g/sec	0.269 0.034 g/sec	X= 436970 Y= 4851582
13 Snow Perf. Arts Cent.Emer. Gen. (Note 2)	SNOW_GEN	75.00 22.86 m	600 588.56 K	3.00	1.13 0.34 m	0	0	0.00 0.00 m/sec	YES	0.088 0.011 g/sec	0.087 0.011 g/sec	1.246 0.157 g/sec	0.269 0.034 g/sec	X= 437059 Y= 4852164
14 Romney Bldg Emer. Gen. (Note 2)	ROMN_GEN	66.00 20.12 m	600 588.56 K	3.00	1.13 0.34 m	0	0	0.00 0.00 m/sec	YES	0.148 0.019 g/sec	0.145 0.018 g/sec	2.079 0.262 g/sec	0.448 0.056 g/sec	X= 437112 Y= 4852039
15 Library Emer. Gen. (Note 2)	LIBR_GEN	70.00 21.34 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.256 0.032 g/sec	0.232 0.029 g/sec	3.033 0.382 g/sec	0.717 0.090 g/sec	X= 437139 Y= 4851974
16 Bensen Bldg Emer. Gen. (Note 2)	BENS_GEN	7.00 2.13 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.148 0.019 g/sec	0.145 0.018 g/sec	2.079 0.262 g/sec	0.448 0.056 g/sec	X= 437128 Y= 4851516
17 Smith Bldg Emer. Gen. (Note 2)	SMTH_GEN	40.00 12.19 m	600 588.56 K	8.00	0.67 0.20 m	0	0	0.00 0.00 m/sec	YES	0.176 0.022 g/sec	0.174 0.022 g/sec	2.492 0.314 g/sec	0.538 0.068 g/sec	X= 437251 Y= 4851894
18 Clarke Bldg Emer. Gen. (Note 2)	CLRK_GEN	7.33 2.23 m	964 790.78 K	3.00	0.25 0.08 m	533	199	181.08 55.19 m/sec	NO	0.176 0.022 g/sec	0.174 0.022 g/sec	2.492 0.314 g/sec	0.538 0.068 g/sec	X= 437262 Y= 4852013

Appendix B
BYU-Idaho Model Input

Source Name	Source ID	Stack Ht. (ft.)	Stack Temp. (F)	Act. Stack Dia. (in)	Eff. Stack Dia. (ft)	Vol. Flow (ACFM)	Vol. Flow (SCFM)	Exit Vel. (ft/sec)	Horz Exit	PM10 Em. Rate (lb/hr)	SO2 Em. Rate (lb/hr)	NOx Em. Rate (lb/hr)	CO Em. Rate (lb/hr)	UTM Coord. (m)
19 Radio/Graphics Bldg Emer. Gen. (Note 2)	R_GR_GEN	55.00 16.76 m	600 588.56 K	3.00	1.12 0.34 m	2800	1400	0.00 0.00 m/sec	YES	0.117 0.015 g/sec	0.116 0.015 g/sec	1.661 0.209 g/sec	0.359 0.045 g/sec	X= 437421 Y= 4851720
20 Spori Bldg Emer. Gen. (Note 2)	SPRI_GEN	8.33 2.54 m	964 790.78 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.074 0.009 g/sec	0.072 0.009 g/sec	1.038 0.131 g/sec	0.224 0.028 g/sec	X= 437171 Y= 4852107
21 Ricks Bldg Emer. Gen. (Note 2)	RIKS_GEN	5.50 1.68 m	964 790.78 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.236 0.030 g/sec	0.232 0.029 g/sec	3.033 0.382 g/sec	0.717 0.090 g/sec	X= 437318 Y= 4851431

Note 1. Boiler No. 5 emission rates are based on firing No 2 fuel oil @ 0.05% S.

Note 2. Maximum allowable emission rates are shown for the emergency generators. The emergency generators operate up to three hours one day per month for testing and maintenance, and are limited by permit to a maximum of 500 hours per year operation. Therefore, the emission rates input to the 3-hr, 24-hr, and annual models are scaled accordingly with the generator emission rates appearing in this appendix multiplied by the ratio: (500 hrs / 8760 hrs) for the annual model, (3 hrs / 24 hrs) for the 24 hour model, and maximum allowable emission rates appearing here for the 3-hr model.

Note 3. See Appendix C. Actual diameter and exit velocity used for horizontal stack based on calculation of bouyancy/momentum plume rise calculations.

Appendix C

Kimball Generator Plume Rise Calculations

Appendix C
Kimball Building Emergency Generator Plume Rise Calculations

Neutral / Unstable Conditions

$F_b = gvd^2 (\Delta T / 4T_s)$ — 588.7 K = 600°F; 310.2 K = 98.96°F

$g =$	9.8 m/sec^2	gravitational acceleration (9.8 m/sec^2)
$v =$	57.6 m/sec	stack velocity (m/sec)
$d =$	0.203 m	stack diameter (m)
$T_a =$	310.2 K	amb. temp. (98.96°F, maximum temperature, Rexburg, ID 2003-2007)
$T_s =$	588.7 K	stack gas temperature (1002°F)
$\Delta T =$	278.5 K	difference between stack temperature and ambient temperature (K)
$F_b =$	2.75	buoyancy flux

F_b is <55 so the following formula is used to calculate delta T_c for neutral/unstable conditions

$\Delta T_c = 0.0297\ T_s\ (v^{1/3} / d^{2/3})$

$\Delta T_c =$ 195.2

ΔT is > ΔTc, therefore plume rise under neutral/unstable conditions will be dominated by bouyancy.

Stablity Class E

$s = g((\partial\theta/\partial z) / T_a)$

where:

$\partial\theta/\partial z =$ 0.02 potential temperature gradient with height (K/m)

$T_a =$ 310.2 ambient temperature (K)

$s =$ 0.00063

$\Delta T_c = 0.019582\ T_s\ v\ \sqrt{s}$

$\Delta T_c =$ 16.7

ΔT is > ΔTc, therefore plume rise in Stability Class E will be dominated by bouyancy.

Stablity Class F

$s = g((\partial\theta/\partial z) / T_a)$

where:

$\partial\theta/\partial z =$ 0.035 potential temperature gradient with height (K/m)

$T_a =$ 310.2 ambient temperature (K)

$s =$ 0.00111

$\Delta T_c = 0.019582\ T_s\ v\ \sqrt{s}$

$\Delta T_c =$ 22.1

ΔT is > ΔTc, therefore plume rise in Stability Class F will be dominated by bouyancy.

Appendix B

Emission Rate Calculations

Appendix B
Emission Rate Calculations

Unit	MMbtu/hr	Total lb/hr SO_2 @ 0.72% S
All Coal Boilers[1]	113.34	142.808
Boiler 2 (Coal)	26.67	33.604
Boiler 3 (Coal)	40.00	50.400
Boiler 4 (Coal)	46.67	58.804
Boiler 5 (Nat. Gas / No. 2 Oil)	45.00	

1. Permit limit on coal fired is assigned to Boilers 2 through 4. SO_2 emission rate is based on the limit for three boilers and assigned as shown above.

EMISSION SOURCE INPUT DATA

Maximum Heat Input (Million Btu Per Hour):	113.34	Coal Boilers Only
Coal Type	Sub bituminous	
Coal Heat Content, Btu/lb	13000	
Maximum Fuel Sulfur Content (%):	0.72	
Maximum Hourly Fuel Usage (Tons Per Hour)	5.667	
Maximum Capacity Factor (Hours Per Year or Percentage)	8760	
Maximum Annual Fuel Usage (Tons Per Year)	8300	
Selected Boiler Type:	Spreader stoker, sub-bituminous	

	Uncontrolled Emission Factor (lb/ton)	Emission Factor Reference	Uncontrolled Emission Factor (lb/mmbtu)	Uncontrolled Emissions (lb/hr)
SO_2	25.2	AP-42 Table 1.1-3	1.26	142.808

Generator Emission Rate Calculations	PM_{10}	SO_2	NOx	CO
AP-42 Emission Factor (lb/hp-hr) (Chapter 3.3-1, Table 3.3-1)	0.0022	0.00205	0.031	0.00668

Generator Emission Unit	Emission Rate PM_{10} (lbs/hr)	SO_2 (lbs/hr)	NOx (lbs/hr)	CO (lbs/hr)	Generator Rating (kW)	Engine Rating (HP)
Heat Plant	0.885	0.825	12.471	2.687	300	402.3
Kimball	1.292	1.204	18.208	3.924	438	587.358
Hart	0.295	0.275	4.157	0.896	100	134.1
Physical Facilities	0.089	0.082	1.247	0.269	30	40.23
Manwaring Ctr	0.177	0.165	2.494	0.537	60	80.46
Kirkham Bldg	0.059	0.055	0.831	0.179	20	26.82
Aux Serices	0.089	0.082	1.247	0.269	30	40.23
Austin Bldg	0.089	0.082	1.247	0.269	30	40.23
Snow	0.089	0.082	1.247	0.269	30	40.23
Romney	0.148	0.137	2.079	0.448	50	67.05
Library	0.236	0.220	3.326	0.717	80	107.28
Benson	0.148	0.137	2.079	0.448	50	67.05
Smith	0.177	0.165	2.494	0.537	60	80.46
Clarke	0.177	0.165	2.494	0.537	60	80.46
Radio-Graphic Services	0.118	0.110	1.663	0.358	40	53.64
Spori	0.074	0.069	1.039	0.224	25	33.525
Ricks	0.236	0.220	3.326	0.717	80	107.28
Radio Tower	0.015	0.014	0.208	0.045	5	6.705

Appendix C

BYU-Idaho Model Input

Appendix C
BYU-Idaho Model Input

Source Name	Source ID	Stack Ht. (ft.)	Stack Temp. (F)	Act. Stack Dia. (in)	Eff. Stack Dia. (ft)	Vol. Flow (ACFM)	Vol. Flow (SCFM)	Exit Vel. (ft/sec)	Horz Exit	PM10 Em. Rate (lb/hr)	SO2 Em. Rate (lb/hr)	NOx Em. Rate (lb/hr)	CO Em. Rate (lb/hr)	UTM Coord. (m)
1 Coal Boiler #2	BOILER2	80.00 24.38 m	406 480.63 K	30.00	2.50 0.76 m	19027	11648	64.60 19.69 m/sec	NO	4.640 0.585 g/sec	33.604 4.234 g/sec	2.450 0.309 g/sec	5.330 0.672 g/sec	X= 436875 Y= 4851711
2 Coal Boiler #3	BOILER3	80.00 24.38 m	343 445.63 K	38.00	3.17 0.97 m	35800	23637	75.76 23.09 m/sec	NO	5.500 0.693 g/sec	50.400 6.350 g/sec	3.680 0.464 g/sec	8.000 1.008 g/sec	X= 436875 Y= 4851710
3 Coal Boiler #4	BOILER4	80.00 24.38 m	496 530.63 K	37.99	3.17 0.96 m	35800	19853	75.80 23.10 m/sec	NO	8.910 1.123 g/sec	58.804 7.409 g/sec	4.290 0.541 g/sec	9.330 1.176 g/sec	X= 436889 Y= 4851710
4 Gas/Oil Boiler #5 (Note 1)	BOILER5	59.00 17.98 m	360 455.22 K	42.01	3.50 1.07 m	30328	19602	52.51 16.01 m/sec	NO	0.400 0.050 g/sec	6.667 0.840 g/sec	2.700 0.340 g/sec	4.200 0.529 g/sec	X= 436898 Y= 4851714
5 Heat Plant Emer. Gen. (Note 2)	HEAT_GEN EG429	42.00 12.80 m	600.00 588.56 K	5.98	0.50 0.15 m	2061	1031	176.15 53.69 m/sec	NO	0.885 0.112 g/sec	0.825 0.104 g/sec	12.471 1.571 g/sec	2.687 0.339 g/sec	X= 436901 Y= 4851711
6 Kimball Bldg Emer. Gen. (Notes 2 and 3)	KIMB_GEN EG402	12.50 3.81 m	600 588.56 K	8.00	0.67 0.20 m	2000	1000	95.49 29.11 m/sec	YES (Horiz)	1.292 0.163 g/sec	1.204 0.152 g/sec	18.208 2.294 g/sec	3.924 0.494 g/sec	X= 437266 Y= 4851608
7 Hart Bldg Emer. Gen. (Note 2)	HART_GEN EG477	7.00 2.13 m	600 588.56 K	2.01	0.17 0.05 m	182	91	137.62 41.95 m/sec	NO	0.295 0.037 g/sec	0.275 0.035 g/sec	4.157 0.524 g/sec	0.896 0.113 g/sec	X= 437008 Y= 4851994
8 Physical Facilities Emer. Gen. (Note 2)	PHYP_GEN EG434	6.00 1.83 m	600 588.56 K	3.00	0.25 0.08 m	5000	2500	0.00 0.00 m/sec	YES	0.089 0.011 g/sec	0.082 0.010 g/sec	1.247 0.157 g/sec	0.269 0.034 g/sec	X= 436904 Y= 4851558
9 Manwaring Center Emer. Gen. (Note 2)	MAN_GEN EG442	20.00 6.10 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.177 0.022 g/sec	0.165 0.021 g/sec	2.494 0.314 g/sec	0.537 0.068 g/sec	X= 437101 Y= 4851827
10 Kirkham Bldg Emer. Gen. (Note 2)	KIRK_GEN EG473	20.00 6.10 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.059 0.007 g/sec	0.055 0.007 g/sec	0.831 0.105 g/sec	0.179 0.023 g/sec	X= 437217 Y= 4852109
11 Auxillary Services Emer. Gen. (Note 2)	ASER_GEN EG479	27.00 8.23 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.089 0.011 g/sec	0.082 0.010 g/sec	1.247 0.157 g/sec	0.269 0.034 g/sec	X= 437115 Y= 4851389
12 Austin Tech Emer. Gen. (Note 2)	AUST_GEN EG414	6.00 1.83 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.089 0.011 g/sec	0.082 0.010 g/sec	1.247 0.157 g/sec	0.269 0.034 g/sec	X= 436970 Y= 4851582
13 Snow Perf. Arts Cent.Emer. Gen. (Note 2)	SNOW_GEN EG403	7.00 2.13 m	600 588.56 K	3.00	1.13 0.34 m	0	0	0.00 0.00 m/sec	YES	0.089 0.011 g/sec	0.082 0.010 g/sec	1.247 0.157 g/sec	0.269 0.034 g/sec	X= 437023 Y= 4852124
14 Romney Bldg Emer. Gen. (Note 2)	ROMN_GEN EG404	9.00 2.74 m	600 588.56 K	3.00	1.13 0.34 m	0	0	0.00 0.00 m/sec	YES	0.148 0.019 g/sec	0.137 0.017 g/sec	2.079 0.262 g/sec	0.448 0.056 g/sec	X= 437135 Y= 4852071
15 Library Emer. Gen. (Note 2)	LIBR_GEN EG431	8.00 2.44 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.236 0.030 g/sec	0.220 0.220 g/sec	3.326 0.419 g/sec	0.717 0.090 g/sec	X= 437134 Y= 4851984
16 Bensen Bldg Emer. Gen. (Note 2)	BENS_GEN EG413	7.00 2.13 m	600 588.56 K	3.00	0.25 0.08 m	0	0	0.00 0.00 m/sec	YES	0.148 0.019 g/sec	0.137 0.017 g/sec	2.079 0.262 g/sec	0.448 0.056 g/sec	X= 437128 Y= 4851516
17 Smith Bldg Emer. Gen. (Note 2)	SMTH_GEN EG480	8.00 2.44 m	600 588.56 K	8.00	0.67 0.20 m	0	0	0.00 0.00 m/sec	YES	0.177 0.022 g/sec	0.165 0.021 g/sec	2.494 0.314 g/sec	0.537 0.068 g/sec	X= 437271 Y= 4851938
18 Clarke Bldg Emer. Gen. (Note 2)	CLRK_GEN EG401	8.00 2.44 m	600 588.56 K	3.00	0.25 0.08 m	397	199	134.79 41.09 m/sec	NO	0.177 0.022 g/sec	0.165 0.021 g/sec	2.494 0.314 g/sec	0.537 0.068 g/sec	X= 437262 Y= 4852013

Appendix C
BYU-Idaho Model Input

Source Name	Source ID	Stack Ht. (ft.)	Stack Temp. (F)	Act. Stack Dia. (in)	Eff. Stack Dia. (ft)	Vol. Flow (ACFM)	Vol. Flow (SCFM)	Exit Vel. (ft/sec)	Horz Exit	PM10 Em. Rate (lb/hr)	SO2 Em. Rate (lb/hr)	NOx Em. Rate (lb/hr)	CO Em. Rate (lb/hr)	UTM Coord. (m)
19 Radio/Graphics Bldg Emer. Gen.	R_GR_GEN	6.00	600	3.00	1.12	2800	1400	0.00	YES	0.118	0.110	1.663	0.358	X= 437431
(Note 2)	EG409	1.83 m	588.56 K		0.34 m			0.00 m/sec		0.015 g/sec	0.014 g/sec	0.210 g/sec	0.045 g/sec	Y= 4851702
20 Spori Bldg Emer. Gen.	SPRI_GEN	8.00	600	3.00	0.25	0	0	0.00	YES	0.074	0.069	1.039	0.224	X= 437212
(Note 2)	EG410	2.44 m	588.56 K		0.08 m			0.00 m/sec		0.009 g/sec	0.009 g/sec	0.131 g/sec	0.028 g/sec	Y= 4852096
21 Ricks Bldg Emer. Gen.	RIKS_GEN	6.00	600	3.00	0.25	0	0	0.00	YES	0.236	0.220	3.326	0.717	X= 437318
(Note 2)	EG412	1.83 m	588.56 K		0.08 m			0.00 m/sec		0.030 g/sec	0.028 g/sec	0.419 g/sec	0.090 g/sec	Y= 4851431
22 Radio Tower Gen.	EG408	11.00	600	1.75	0.15	0	0	0.00	YES	0.015	0.014	0.208	0.045	X= 437053
(Note 2)		3.35 m	588.56 K		0.04 m			0.00 m/sec		0.002 g/sec	0.002 g/sec	0.026 g/sec	0.006 g/sec	Y= 4851096

Note 1. Boiler No. 5 emission rates are based on firing No 2 fuel oil @ 0.05% S.

Note 2. Maximum allowable emission rates are shown for the emergency generators. The emergency generators operate up to three hours one day per month for testing and maintenance, and are limited by permit to a maximum of 500 hours per year operation. Therefore, the emission rates input to the 3-hr, 24-hr, and annual models are scaled accordingly with the generator emission rates appearing in this appendix multiplied by the ratio: (500 hrs / 8760 hrs) for the annual model, (3 hrs / 24 hrs) for the 24 hour model, and maximum allowable emission rates appearing here for the 3-hr model.

Note 3. See Appendix C. Actual diameter and exit velocity used for horizontal stack based on calculation of bouyancy/momentum plume rise calculations.

Appendix D

Kimball Building Generator Plume Rise Calculations

Appendix D
Kimball Building Emergency Generator Plume Rise Calculations

Neutral / Unstable Conditions

$F_b = gvd^2 (\Delta T / 4T_s)$ 811.7 K = 1002°F
312.6 K = 103.3°F

$g =$	9.8 m/sec^2	gravitational acceleration (9.8 m/sec^2)
$v =$	57.6 m/sec	stack velocity (m/sec)
$d =$	0.203 m	stack diameter (m)
$T_a =$	312.5 K	amb. temp. (103.1°F, maximum temperature, Pocotello, ID 1990-1995)
$T_s =$	811.7 K	stack gas temperature (1002°F)
$\Delta T =$	499.2 K	difference between stack temperature and ambient temperature (K)
$F_b =$	3.58	buoyancy flux

F_b is <55 so the following formula is used to calculate delta T_c for neutral/unstable conditions

$\Delta T_c = 0.0297\ T_s\ (v^{1/3} / d^{2/3})$

$\Delta T_c =$ 269.2

ΔT is > ΔTc, therefore plume rise under neutral/unstable conditions will be dominated by bouyancy.

Stablity Class E

$s = g((\partial\theta/\partial z) / T_a)$

where:

$\partial\theta/\partial z =$ 0.02 potential temperature gradient with height (K/m)

$T_a =$ 312.5 ambient temperature (K)

$s =$ 0.00063

$\Delta T_c = 0.019582\ T_s\ v \sqrt{s}$

$\Delta T_c =$ 22.9

ΔT is > ΔTc, therefore plume rise in Stability Class E will be dominated by bouyancy.

Stablity Class F

$s = g((\partial\theta/\partial z) / T_a)$

where:

$\partial\theta/\partial z =$ 0.035 potential temperature gradient with height (K/m)

$T_a =$ 312.5 ambient temperature (K)

$s =$ 0.00110

$\Delta T_c = 0.019582\ T_s\ v \sqrt{s}$

$\Delta T_c =$ 30.3

ΔT is > ΔTc, therefore plume rise in Stability Class F will be dominated by bouyancy.

Appendix E

Predicted Concentrations

Appendix E
Predicted Concentrations

File	Pol	Average	Group	Rank	Conc. ($\mu g/m^3$)	East(X) (m)	North(Y) (m)	Elev (m)	Flagpole Ht (m)	Time (YYMMDDHH)
BYUI 1 3 and 8 hr_2003_CO.USF	CO	8-HR	ALL	2ND	1470.92908	436900.00	4851550.00	1494.74	0.00	03011608
BYUI 1 3 and 8 hr_2004_CO.USF	CO	8-HR	ALL	2ND	1544.49316	436900.00	4851550.00	1494.74	0.00	04012208
BYUI 1 3 and 8 hr_2005_CO.USF	CO	8-HR	ALL	2ND	1526.78552	436900.00	4851550.00	1494.74	0.00	05112008
BYUI 1 3 and 8 hr_2006_CO.USF	CO	8-HR	ALL	2ND	1161.04810	436900.00	4851550.00	1494.74	0.00	06120624
BYUI 1 3 and 8 hr_2007_CO.USF	CO	8-HR	ALL	2ND	1393.78943	436900.00	4851550.00	1494.74	0.00	07030708
BYUI 1 3 and 8 hr_2003_CO.USF	CO	1-HR	ALL	2ND	3568.97388	436900.00	4851550.00	1494.74	0.00	03102502
BYUI 1 3 and 8 hr_2004_CO.USF	CO	1-HR	ALL	2ND	3559.51904	436900.00	4851550.00	1494.74	0.00	04012122
BYUI 1 3 and 8 hr_2005_CO.USF	CO	1-HR	ALL	2ND	3521.05127	436900.00	4851550.00	1494.74	0.00	05100324
BYUI 1 3 and 8 hr_2006_CO.USF	CO	1-HR	ALL	2ND	3504.82959	436900.00	4851550.00	1494.74	0.00	06101223
BYUI 1 3 and 8 hr_2007_CO.USF	CO	1-HR	ALL	2ND	3499.97754	436900.00	4851550.00	1494.74	0.00	07062205
BYUI annual_2003_NOX.USF	NOX	ANNUAL	ALL	1ST	42.83760	436900.00	4851550.00	1494.74	0.00	1 YRS
BYUI annual_2004_NOX.USF	NOX	ANNUAL	ALL	1ST	42.29657	436900.00	4851550.00	1494.74	0.00	1 YRS
BYUI annual_2005_NOX.USF	NOX	ANNUAL	ALL	1ST	43.08385	436900.00	4851550.00	1494.74	0.00	1 YRS
BYUI annual_2006_NOX.USF	NOX	ANNUAL	ALL	1ST	41.22423	436900.00	4851550.00	1494.74	0.00	1 YRS
BYUI annual_2007_NOX.USF	NOX	ANNUAL	ALL	1ST	39.46912	436900.00	4851550.00	1494.74	0.00	1 YRS
BYUI annual_2003_PM_10.USF	PM_10	ANNUAL	ALL	1ST	4.14722	436991.00	4851934.00	1487.7	12.50	1 YRS
BYUI annual_2004_PM_10.USF	PM_10	ANNUAL	ALL	1ST	3.89502	436991.00	4851934.00	1487.7	12.50	1 YRS
BYUI annual_2005_PM_10.USF	PM_10	ANNUAL	ALL	1ST	3.52183	436991.00	4851934.00	1487.7	12.50	1 YRS
BYUI annual_2006_PM_10.USF	PM_10	ANNUAL	ALL	1ST	3.81277	436991.00	4851934.00	1487.7	12.50	1 YRS
BYUI annual_2007_PM_10.USF	PM_10	ANNUAL	ALL	1ST	4.11157	436991.00	4851934.00	1487.7	12.50	1 YRS
BYUI 24 hr_2003_PM_10.USF	PM_10	24-HR	ALL	2ND	36.81147	436900.00	4851550.00	1494.74	0.00	03022724
BYUI 24 hr_2004_PM_10.USF	PM_10	24-HR	ALL	2ND	32.15874	436900.00	4851550.00	1494.74	0.00	04012224
BYUI 24 hr_2005_PM_10.USF	PM_10	24-HR	ALL	2ND	27.99386	436900.00	4851550.00	1494.74	0.00	05083124
BYUI 24 hr_2006_PM_10.USF	PM_10	24-HR	ALL	2ND	26.49625	436900.00	4851550.00	1494.74	0.00	06021324
BYUI 24 hr_2007_PM_10.USF	PM_10	24-HR	ALL	2ND	22.96718	436900.00	4851550.00	1494.74	0.00	07012424
BYUI annual_2003_SO2.USF	SO2	ANNUAL	ALL	1ST	30.66602	436974.00	4851967.00	1485.57	15.70	1 YRS
BYUI annual_2004_SO2.USF	SO2	ANNUAL	ALL	1ST	28.46424	436991.00	4851934.00	1487.7	12.50	1 YRS
BYUI annual_2005_SO2.USF	SO2	ANNUAL	ALL	1ST	25.68407	436991.00	4851934.00	1487.7	12.50	1 YRS
BYUI annual_2006_SO2.USF	SO2	ANNUAL	ALL	1ST	27.95436	436991.00	4851934.00	1487.7	12.50	1 YRS
BYUI annual_2007_SO2.USF	SO2	ANNUAL	ALL	1ST	30.30997	436991.00	4851934.00	1487.7	12.50	1 YRS
BYUI 1 3 and 8 hr_2003_SO2.USF	SO2	3-HR	ALL	2ND	1009.20819	437125.00	4852000.00	1490.56	0.00	03080921
BYUI 1 3 and 8 hr_2004_SO2.USF	SO2	3-HR	ALL	2ND	1024.44153	437114.34	4851976.00	1491.54	1.12	04011115
BYUI 1 3 and 8 hr_2005_SO2.USF	SO2	3-HR	ALL	2ND	929.90839	437135.50	4851976.00	1492.08	1.12	05112515
BYUI 1 3 and 8 hr_2006_SO2.USF	SO2	3-HR	ALL	2ND	1029.23682	437125.00	4852000.00	1490.56	0.00	06111521
BYUI 1 3 and 8 hr_2007_SO2.USF	SO2	3-HR	ALL	2ND	1112.95703	437125.00	4852000.00	1490.56	0.00	07092721
BYUI 24 hr_2003_SO2.USF	SO2	24-HR	ALL	2ND	132.80124	436974.00	4851967.00	1485.57	15.70	03030824
BYUI 24 hr_2004_SO2.USF	SO2	24-HR	ALL	2ND	142.79958	436991.00	4851934.00	1487.7	12.50	04031924
BYUI 24 hr_2005_SO2.USF	SO2	24-HR	ALL	2ND	125.93471	436450.00	4851300.00	1491.39	0.00	05030524
BYUI 24 hr_2006_SO2.USF	SO2	24-HR	ALL	2ND	122.41730	436450.00	4851300.00	1491.39	0.00	06120424
BYUI 24 hr_2007_SO2.USF	SO2	24-HR	ALL	2ND	131.11226	436974.00	4851967.00	1485.57	15.70	07022024

See hard copy application for Campus Site Plan drawing and Air Intakes drawing.